## EXPERIENCE OF MINING PROJECT IMPLEMENTATION

Research article

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# Features of evaluating the economic security of peat industry enterprises in the Tver Region of Russia (the industry review)

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**Abstract**
The paper is devoted to the urgent problem of sustainable and economically secure development of enterprises in the Tver Region peat-extracting sector of the economy. Despite the fact that peat deposits are widespread in many regions of Russia, the efficiency of their industrial and economic use is extremely low. The purpose of the study was to determine the features of the assessment and analysis of the economic security of an enterprise that develops peat deposits. The paper examines the relationship between the concepts of "peat rent" and "economic security", and also provides the author's interpretation of their content and essence. An analysis of the existing approaches to assessing the economic security of peat extracting enterprises was carried out, and the use of the rent approach was substantiated based on the data on the peat industry enterprises used in this study. The indicators for assessing the economic security of a peat production were identified. The authors proposed a methodological approach, a feature of which was comprehensive accounting of technical, economic, and natural factors that objectively affected the level of economic security of peat extracting enterprises. The proposed methodological approach also makes it possible to develop recommendations for increasing the flexibility and adaptability of peat extracting enterprises, taking into account the individual conditions of their work. The methodological research toolkit included the fundamentals of economic theory, information methods for processing statistical data, and economic and mathematical modeling. The methodology approbation was carried out through the example of enterprises of the Tver Region peat-extracting industry, which had been at a low ebb (in protracted economic crisis) for a long time. The conclusions, recommendations, and proposals of the study were used in the development of the Regional program "Natural Resources Management and Environmental Protection" for 2017–2022 (Order of the Tver Region Government No. 414-pp of December 26, 2016 as amended on February 7, 2020).

**Key words**
rent, peat industry, economic efficiency, economic security, regional economy, investment attractiveness, regional resources, peat extraction, process technology

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## ОПЫТ РЕАЛИЗАЦИИ ПРОЕКТОВ В ГОРНОПРОМЫШЛЕННОМ СЕКТОРЕ ЭКОНОМИКИ

Научная статья

# Особенности оценки экономической безопасности предприятий торфодобывающей отрасли Тверского региона России (обзор отрасли)

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**Аннотация**
Статья посвящена актуальной проблеме устойчивого и экономически безопасного развития предприятий торфодобывающего сектора экономики Тверского региона. Несмотря на то что торфяные месторождения широко представлены во многих регионах России, эффективность их промышленно-экономического использования крайне низкая. **Цель исследования** заключается в определении особенностей оценки и анализа экономической безопасности предприятия, разрабатывающего торфяные месторождения. В статье рассматривается связь понятий «торфяная рента» и «экономическая безопасность», а также приводится авторская трактовка их содержания. Проведен анализ существующих

подходов к оценке экономической безопасности деятельности добывающих предприятий и обосновано использование рентного подхода по материалам предприятий торфяной отрасли, используемым при проведении данного исследования. Выделен индикатор оценки экономической безопасности торфодобывающего производства. **Предложен методический подход**, особенностью которого является комплексный учет технико-экономических и природных факторов, объективно влияющих на уровень экономической безопасности торфодобывающих предприятий. Предложенный методический подход также позволяет разработать рекомендации для повышения гибкости и адаптивности торфодобывающих предприятий с учетом индивидуальных условий их работы. Методический инструментарий исследования включает положения экономической теории, информационные методы обработки статистических данных и экономико-математическое моделирование. **Апробация методики** проведена на примере предприятий торфодобывающего комплекса Тверского региона, которые довольно продолжительное время находятся в состоянии затянувшегося экономического кризиса. **Выводы, рекомендации и предложения** исследования использовались при разработке региональной программы «Управление природными ресурсами и охрана окружающей среды» на 2017–2022 годы (Постановление Правительства Тверской области от 26 декабря 2016 года № 414-пп с изменениями на 7 февраля 2020 г.).

**Ключевые слова**
рента, торфяная отрасль, экономическая эффективность, экономическая безопасность, региональная экономика, инвестиционная привлекательность, региональные ресурсы, отраслевой комплекс, добыча торфа, технология

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## Introduction

Russia possesses the world's largest peat reserves, but they have been insufficiently surveyed and are poorly used in the national economy. The Tver Region is located in the central part of the Central Federal District of Russia. The Region mineral resource base is rather scarce in terms of the types of minerals and mostly represented by common natural resources, such as peat, sapropel, brown coal, sand (glass-making sand and mason sand), gravel and crushed stone, clay (low-melting clay and high-melting clay, bentonite clay), limestone (pure limestone, marmorized limestone, dolomitized limestone, siliceous limestone), marl, quartzite and quartz, mineral therapeutic muds and mineral waters. The explored mineral resource base of the Region includes about 3,738 deposits of minerals, but the Region industry has developed only 8% of them, while only 10 of the 15 known types of minerals are mined [1, 2]. The basis of the Tver Region economy is industry, whose enterprises bring up to 30% of the gross regional product. In 2019, the Region industrial enterprises shipped marketable products to the amount of 444 billion rubles (versus 442 billion rubles in 2018). However, in the gross regional product (GRP) structure, the share of the mining (extracting) sector is less than 1%. Such insignificant contribution to the regional economy evidences extremely ineffective use of the local mineral resource base that can lead to increasing the resource "dependence" (nonindependence) of the Tver Region sectors of industry.

Peat is an unique natural complex chemical product containing wide range of organic and inorganic chemical compounds, substances that are of great importance for many industries and areas of economic use. In recent years, the global volume of peat production has decreased by about four times. The rates of decline in peat production in peat-extracting regions of Russia were especially high: the production dropped from 13.6 mln tons in 2000 to 2 mln tons in 2019). In conditions of economic instability, the regions attempt to turn the corner through the rational use of their own mineral resources [3, 4].

One of the priority areas in the regional program of the Tver Region "Natural Resources Management and Environmental Protection" for 2017–2022 is improving the efficiency of using local natural resource potential. But despite this, the Tver Region mining complex is poorly represented in the regional economy GRP pattern. The share of mining industry in the total gross regional product does not exceed three percent. Even the long-term target program of the Tver Region "Comprehensive program for improving energy efficiency of the regional economy and reducing energy costs in the public sector of the Tver Region for the period up to 2030", assuming creation of conditions for the expansion of the use of renewable energy sources, secondary energy resources, and local fuels, did not provided real incentives for the development of peat enterprises. Despite the attempts of the Tver Region Government to revive the peat industry, the statistics show that the long economic crisis led to the bankruptcy of many peat extracting enterprises, while the economic security of the few operating peat producers became at risk. For instance, in the peat industry of the Tver Region, the share of closed down peat-extracting enterprises amounted to 90%. The most common reasons for their closing down were:

– the absence of clearly defined place of peat and peat deposits in the federal legislation of the country;

– the lack of intelligible economic policy in relation to peat enterprises regarding payments for the use of natural resources and land tax;

– tax arrears, especially on royalty, and debts on obligatory payments to other funds, rent arrears (to the regional budget);

– high degree of wear and tear of equipment and insignificant renewal of the equipment fleet with modern machines at the peat-extracting enterprises, as well as the absence of domestic machine building sector for peat extraction;

– outdated techniques for development of peat deposits that do not meet up-to-date technical and economic requirements, as well as strong dependence of the production process of peat extraction on weather conditions;

– the lack of specialized information technologies for design and management of peat production;

– low demand for peat products caused by the lack of strategic market research for penetrating into new markets and creating new markets, the lack of business planning and investment in the production;

– the peat enterprises face shortage of working capital;

– the lack of research on the interrelationships of production, technical, geological and natural factors with cost effectiveness indicators of the peat-extracting enterprises.

Many researchers are still discussing the issues of increasing cost effectiveness and investment attractiveness of the peat extracting sector, but clear solutions on such topical issues have not yet been developed. At the federal level, various models of management decisions have been proposed, including the creation of appropriate legislative framework. As a result, until today the Federal Law "On Peat" has not been adopted. Meanwhile, peat is quite widely represented in the the mineral resource base of all regions of Russia and belongs to the category of common, renewable resources with wide range of economic uses [5]. In addition, the peat-extracting and peat-processing sectors of the regional economy are the sphere of small and medium-sized businesses. In turn, the growth in the number of small and medium-sized businesses can rightfully be considered an an indicator of favorable investment climate, economic and resource security, as well as economic development of a region.

## Research Methodology

In the practice of assessing the economic efficiency of the peat industry enterprises, an approach that is generally common for all mining enterprises is used, while the specifics of peat production are not taken into account. Therefore, most of the methods for analyzing and assessing the economic efficiency of peat extracting enterprises produce inadequate results [6–10]. In addition, no overall assessment of the current economic condition of the peat industrial sector and its importance for regional economy is available. It should be noted that there are practically no attempts to assess the level of economic security and economic efficiency of the peat industry, while peat is the most widespread resource found in all regions of Russia, and its commercial development is carried out in 20 constituent entities of the Russian Federation. Unsustainable development of the peat industry enterprises leads to growing risks of losing economic security and instability in the development of the mining sector of the regional economy.

Modern economic literature can not offer unambiguous and clear methods for assessing the level of both economic efficiency and economic security of enterprises. There are quite a few methods for assessing the level of economic security, and they differ in the degree of complexity and laboriousness of calculations, as well as in the set of information data: methods of expert assessments, statistical methods, multi-criteria methods, comprehensive analysis of economic performance, a survey method, methods of "game theory", etc. Each author offers his own methodology for identifying threats to sustainable development of enterprises. Some believe that economic security is a dynamic system of indicators, and the level of economic security should be assessed by the rate of change of these indicators over time (that is, based on relative values), this is a kind of economic potential for the development of an enterprise. Others propose a system of criteria and indicators (absolute values) of the economic performance, most often reducing the economic security assessment of an enterprise to determining the financial condition and crisis level. At the same time, it is believed that economic security reflects the production sustainable development and is closely connected with its economic efficiency. It should be noted that in the case of assessing the economic activity sustainability of peat extracting enterprises, it is necessary to know the optimal values (threshold values) of the parameters characterizing the economically efficient condition of an enterprise. And here a problem arises, because for peat industry, practically no studies on the economic efficiency parameters and the threshold value assessment are available.

Analysis of scientific views in the field of determining economic security allowed the authors to concretize this concept for peat industry: the economic security of peat industry is a sustainable development of the peat extracting enterprises of the sector. At the

same time, the peat extracting enterprises should demonstrate high adaptability and flexibility to internal and external threats to economic activities, be independent in matters of their development and have ability to defend against any types of threats. Fig. 1 presents a methodological scheme for diagnosing the economic security of peat extracting enterprises. To make anti-crisis decision on the selection and adjustment of business models and strategies for the development of a peat extracting enterprise, it is necessary to have clear understanding of the methodology for diagnosing economic security. In the proposed methodology, a comprehensive analysis of all elements of the economic security of an enterprise is carried out using the data of economic, financial, and production reporting of peat-extracting enterprises (see Fig. 1).

From the economic theory viewpoint, the concept of natural resource rent can be applied to increase the efficiency of the use of mineral resources. Strictly speaking, the value of natural resources is characterized by their ability to bring a profit [11].

In the peat industry, the factors and mechanism of rent generation remain poorly understood. In the author's interpretation, peat rent is a kind of natural mining rent, which is generated only in the peat-extracting industry and is relatively permanent due to self-restoring ability of peat. The need for evaluating and separating peat rent from profit in current socio-economic conditions is determined by the very specificity of peat production, by the fact that there are no two identical peat deposits in nature, and therefore the profits of different peat-extracting enterprises will differ mainly due to differences in mining-and-geological and climatic operating conditions, as well as different levels of innovativeness of peat extraction methods [12–15].

## Research Method and Data

The Tver Region occupies leading place in terms of peat reserves, it is here that 2,082 mln tons peat (about 50% of peat reserves of the Central Federal District of Russia) (in conversion to 40% moisture content) are located. For the Tver Region, the peat industry has long been the basis of the regional mining sector, but at present its role is insignificant (Table 1). Until 1990, the Region produced about 6 mln tons of peat annually. At present, the total annual production of all peat enterprises in Russia is 1.5 mln tons. Traditionally, the extracted peat was used as a standby fuel at regional thermal power plants, but with the transition to natural gas, the share of peat in the fuel balance dropped to about 1%. Another traditional field of using peat — the agro-industrial complex — demonstrate

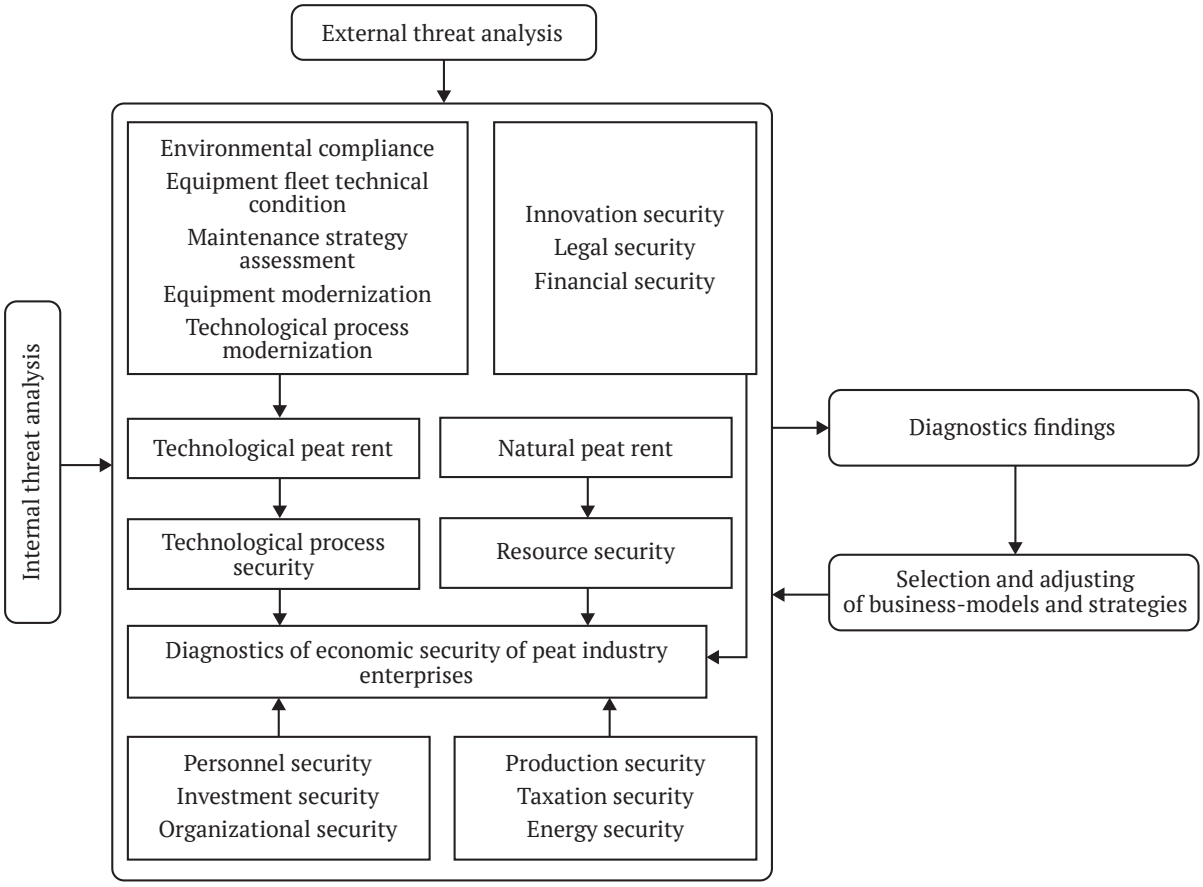


**Fig. 1.** Methodology for the analysis and assessment of economic security *(compiled by the authors)*

higher demand, but due to the weak solvency of the agricultural enterprises, the solvent demand for peat products is extremely weak [16–19].

As seen from Table 1, the peat-extracting sector products amount to less than 1% of the volume of shipped goods of the Tver Region mining sector of economy. Moreover, the highest share of unprofitable enterprises is also in the peat industry. The mining complex of the Tver Region is based on nonmetallic industries, which mainly extract resources for the building industry. As for the peat-extracting industry, already in 2016 up to 90% of its enterprises were at the stage of bankruptcy, and this, in turn, evidenced extremely unstable position of the whole peat industry sector. The rates of peat extraction by all enterprises of the Tver Region peat industry until 2017 were very low, no more than 100 ktpa (Table 2). Therefore, for supporting the peat industry in the region, a peat energy cluster has been organized since 2011, headed by the Bioenergy Corporation.

As seen from Table 2, the volume of mineral resource production by the Tver Region mining sector dropped in 2013, and only by 2019 it reached 50% of the 2012 level. At the same time, the production of fuel and energy resources, represented by peat resources, dropped sharply after 2014 and completely terminated in 2017. However, it should be noted here that, despite the termination of the peat extraction for fuel purposes, the extraction of peat for agro-industrial needs grew, albeit at a slow pace. In the Tver Region, the bulk of peat reserves (more than 60%) belongs high-moor deposits, 28% are lowland type deposits, and 11% are of transitional and mixed types. Peat deposits are diverse in terms of area size, type, thickness and structure. The variety of peat in terms of geological composition and physicochemical properties makes it possible to use the category of "peat rent" as an indicator of the efficiency of business activity of peat extracting enterprises, which allows assessing the peat producer economic security [20–24]. To assess economic security of the peat extracting enterprises, the following methodology was developed (Fig. 1):

1. All technical, economic, production and financial information was applied to the elements of economic security (Table 3).

2. For each element, a set of basic indicators was determined (Table 4), and the threshold values were determined as the average values for all peat enterprises in the Tver Region.

3. Based on Table 5 data, the indicators were calculated for certain levels of economic security.

4. The following points were assigned by the method of expert assessments: 0 points – stable, 6 points – threshold, 12 points – critical, 18 points – crisis. The levels of economic security of a peat extracting enterprise: stable (*S*), threshold (*T*), critical (*C*), crisis (*CR*). The economic security index of a peat enterprise ($ES_{pe}$) was determined as an average value by formula:

$$ES_{pe} = \frac{\sum X_i}{\sum N_i} \quad (1)$$

where $\sum X_i$ – scores of the parameters from Table 4; $\sum N_i$ is the number of the parameters from Table 5. Ranks of the economic security level were determined by the authors after calculating the index of economic security: stable (from 0 to 6 points); threshold (from 6 to 12 points); critical (from 12 to 18 points); crisis (over 18 points).

Table 1

**Mining sector of the Tver Region in 2016**

| Indicator | Raw materials for cement industry | Peat industry | Sand and gravel mix extraction | Clay extraction | Total |
|---|---|---|---|---|---|
| Volume of shipped products, bln rubles | 499 | 0,5 | 362 | 241 | 1,102.5 |
| Average number of employees, persons | 350 | 100 | 200 | 230 | 880 |
| Average monthly wage, rubles | 33,500 | 12,300 | 26,293 | 29,120 | 21,803 |
| Share of unprofitable enterprises, % | 1 | 90 | 2 | 1 | – |

*Source:* compiled by the authors based on the data of the Tver Region office of the Federal State Statistics Service https://tverstat.gks.ru/

Table 2

**Dynamics of the Tver Region mining sector production volume and the data on the peat industry production for fuel and energy and agricultural needs, mln rubles**

| Peat extracting sector products | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Commercial products of the mining sector | 2,216 | 1,896 | 1,517 | 788 | 726 | 774 | 877 | 1,102 |
| Extraction of fuel and energy resources | 590 | 613 | 287 | 0,4 | 1,4 | – | – | – |
| Extraction of peat for agriculture | 2.3 | 1.7 | 1.4 | 1.55 | 1.6 | 1.68 | 1.7 | 1.75 |

*Source:* compiled by the authors based on the data of the Tver Region office of the Federal State Statistics Service https://tverstat.gks.ru/

Table 3

**Characteristics of a peat extracting enterprise economic security elements (fragment)**

| Element | Characteristics |
|---|---|
| Technological process security | Compliance of the process equipment fleet structure with the requirements of modern peat extraction processes, environmental protection and enterprise strategy |
| Resourse security | Proven provision with the required volumes of peat reserves of proper geological quality, effective use of favorable conditions of the peat extracting season |
| Financial security | Optimal and sufficient equity to debt ratio |
| Investment availability security | Compliance of the level of business activity with the selected development strategy |
| Taxation security | Fluctuations in the MET rate for peat, lease and environmental payments, compliance of the tax regime with the selected business strategy |
| Personnel security | Provision with skilled personnel |
| Innovation security | Availability of titles of protection (patents, copyright certificates, etc.). Share of innovative products in the product mix |
| … | … |

*Source*: compiled by the authors.

Table 4

**Threshold score of the key indicators of a peat enterprise economic security (fragment)**

| No. | Indicator | S | T | C | CR |
|---|---|---|---|---|---|
| 1 | Wear (W) rate, % | W ⩽ 50 | 50 < W ⩽ 70 | 70 < W ⩽ 90 | W > 90 |
| | Machinery readiness (MR) level, % | MR ⩾ 100 | 100 < MR ⩽ 80 | 80 < MR ⩽ 60 | MR < 60 |
| | Share of technological rent (Rt), % | $R_t$ ⩾ 15 | 10 < $R_t$ ⩽ 15 | 5 < $R_t$ ⩽ 10 | $R_t$⩽ 5 |
| | Return on assets (ROA) | ROA ⩾ 2 | 1.5 ⩽ ROA <2 | 1 ⩽ ROA < 1.5 | ROA < 1 |
| | Cost growth (CG) rate, % | CG ⩽ 100 | 100 < CG ⩽ 200 | 200 < CG ⩽ 300 | CG > 300 |
| 2 | Share of rent due to peat quality Rpq, % | $R_{pq}$ ⩽ 30 | 20 < $R_{pq}$ ⩽30 | 10 < $R_{pq}$ ⩽ 20 | $R_{pq}$ ⩽ 10 |
| | The rate of increase in production volumes (PV), % | PV ⩾ 100 | 90 < PV ⩽ 100 | 80 < PV ⩽ 90 | PV ⩽ 70 |
| | Provision with reserves (PR), % | O ⩾ 100 | 100 < O ⩽ 80 | 80 < O ⩽ 50 | O < 50 |
| 3 | Liquidity level (L) | L ⩽ 1.5 | 1 < L ⩽ 1.5 | 1.3 < L ⩽ 1.5 | L < 1 |
| | Solvency level (Solv) | Solv ⩾ 0.5 | 0.4 < Solv ⩽ 0,5 | 0.3 < Solv ⩽ 0.4 | Solv < 0.3 |
| | Return on sales (ROS), % | ROS ⩾ 15 | 10 ⩽ ROS< 15 | 5 ⩽ ROS< 10 | ROS< 5 |
| | Enterprise profitability (EP), % | EP ⩾ 20 | 15 ⩽ EP <20 | 10 ⩽EP<15 | EP <10 |
| 4 | Production investment growth rate (PI), % | PI ⩾ 100 | 80 ⩽ PI < 100 | 60 ⩽ PI < 80 | PI < 60 |
| | Investment level (IL), % | IL > 0.3 | 0.3 ⩽ IL < 0.2 | 0.2 ⩽ IL < 0.1 | IL < 0.1 |
| | Business activity level (BA), % | BA ⩾ 0.6 | 0.6 ⩽ BA < 0.4 | 0.4 ⩽ BA < 0.2 | BA < 0.2 |
| | Production facility modernization level (PFM), % | PFM > 100 | 70 < PFM ⩽ 100 | 50 < PFM ⩽ 70 | PFM < 50 |
| 5 | Peat MET growth rate (MET), % | MET ⩽ 1 | 1< MET ⩽ 3 | 2 < MET ⩽ 4 | MET > 4 |
| | lease rate growth rate (LRG), % | LRG ⩽ 5 | 5 < LRG ⩽ 10 | 10 < LRG ⩽ 15 | LRG > 15 |
| | Refinancing rate (Refin), % | Refin ⩽ 8 | 8 < Refin ⩽ 10 | 10 < Refin ⩽ 12 | Refin > 12 |
| 6 | Personnel turnover rate (PT), % | PT ⩽ 7 | 7 < PT ⩽ 10 | 10 < PT ⩽ 13 | PT > 13 |
| | Average wage growth rate salaries at the enterprise (WGR), % | WGR ⩽ 110 | 100 ⩽ WGR < 110 | 90 ⩽ WGR < 100 | WGR < 90 |
| | Worker productivity (WP) growth rate, % | WP ⩾ 60 | 60 < WP ⩽ 40 | 40 < WP ⩽ 20 | WP < 20 |
| | Ratio of the average wage at the enterprise to that in the Tver Region industry (WR), times | WR ⩾ 0.6 | 0.4 ⩽ WR < 0.6 | 0.2 ⩽ WR < 0.4 | WR < 0.2 |
| 7 | Innovative product volume growth rates (IPG), % | IPG ⩾ 60 | 40 < IPG ⩽ 60 | 40 < IPG ⩽ 20 | IPG < 20 |
| | Share of innovative products in the product mix (IPS), % | IPS ⩾ 50 | 50 < IPS ⩽ 30 | 30 < IPS ⩽ 10 | IPS < 10 |
| … | … | … | … | … | … |

*Source:* compiled by the authors based on the Tver Region peat producing enterprises reporting data

Table 5

**Effect of peat rent on the indicators of economic activity of the Tver Region peat extracting enterprises**

| Indicator | "Peat Company" | "Diakar" | "TEK Tver-regiontorf" | "Tverskaya fuel and energy company" |
|---|---|---|---|---|
| Share of peat rent in profit, % | 40 | 23 | 15 | 10 |
| The ratio of the peat rent portions (of I and II kinds), % | 28/12 | 15/8 | 6/9 | 4/6 |
| The share of the factor effect on the prime cost, %: | | | | |
| – factor of geological quality of peat; | 35 | 31 | 33 | 35 |
| – factor of weather conditions of the peat extracting season | 15 | 15 | 15 | 15 |
| The share of the effect of the used equipment level on the prime cost, % | 40 | 38 | 34 | 30 |
| The share of the effect of the used process (method) level on the prime cost, % | 8 | 8 | 8 | 8 |
| Equity to debt ratio, % | 60/40 | 57/43 | 47/53 | 38/62 |

*Source:* calculated by the authors based on the Tver Region peat producing enterprises reporting data

A feature of the methodology for assessing economic security is the use of peat rent as the main indicator of technological, resource, financial and taxation elements of the security of production and economic activities of a peat extracting enterprise. For example, Figs. 2, 3 demonstrate the relationship between the peat rent and the indicators of economic security of a peat enterprise, given in Table 4. Studies of some indicators of economic security shown in Figs. 2, 3, showed that the prime cost of peat extraction was 20% higher for high-moor peat relative to lowland peat, whereas the productivity of lowland peat deposits was 15% higher than that of high-moor peat deposits. This difference in the indicators is due to the difference in the resource (peat) quality factor (geological quality, deposit configuration, weather conditions of the production season, etc.). The values of economic security of peat enterprises using the same process technology and equipment, but developing peat deposits of different geological quality and natural conditions, differ by the amount of the rent component of income [1–3].

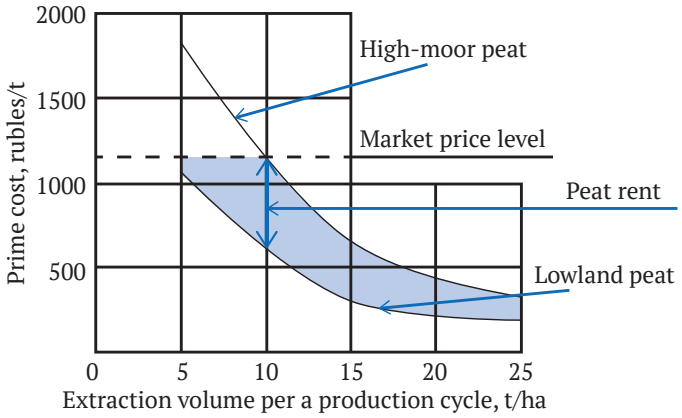


**Fig. 2.** Peat rent, prime cost of milled peat, cyclic collection *(compiled by the authors)*

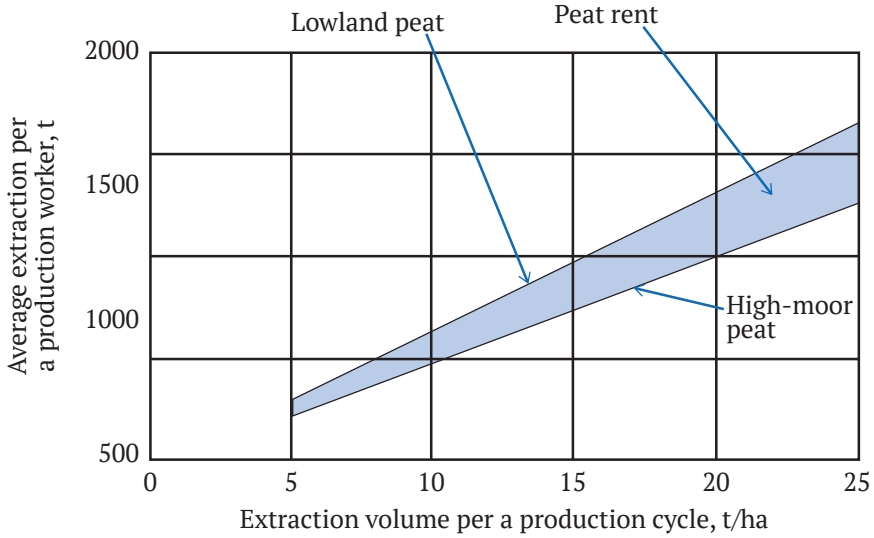


**Fig. 3.** Peat rent, average annual output of a worker, cyclic collection *(compiled by the authors)*

## Findings

The peat extracting industry in the Tver Region in 2019 was represented by 4 enterprises, which develop altogether 6 peat deposits (4 of lowland peat type and 2 of high-moor peat type). Despite the fact that the Tver Region has the largest reserves of peat in the Central Federal District of the Russian Federation, estimated at 2.08 billion tons (on conversion to 40% moisture content), the rate of extraction of the peat was and remains very low, no more than 100 ktpa, and the results of the economic activities of these enterprises in 2019 did not allow overcoming the crisis of the peat industry in the Region.

As shown in Fig. 4, two out of these four peat enterprises in 2019 suffered losses from the economic activities, and this took place at the same economic, technological, weather conditions and taxation regimes. But one should take into account the fact that from 50 to 70% of peat reserves of "TEK Tverregiontorf", "Diakar" and "Peat Company" belong to the lowland types of peat deposits. The features of the effect of peat rent on the indicators of economic activity are presented in Table 5 (based on the authors' research).

The data of Table 5 show that, despite the same peat extraction method and weather conditions in the 2019 production season, the indicators of economic performance are very different. The amounts and ratio of the rent incomes in peat extracting either increase profit or reduce losses. However, the peat rent indicator is strongly dependent on the deposit development (life cycle) stage. For instance, for the "Tverskaya fuel and energy company", the peat rent share is the smallest, 10% of the profit, because peat is mined at the stage of "declining production", when the deposit begins to deplete and the reserves have been worked out by 67%. The results of the economic security score calculations using the method are given in Table 6.

Table 6

**Economic security of peat enterprises**

| Company | Year | | |
|---|---|---|---|
| | 2017 | 2018 | 2019 |
| "Peat Company" | 5.2 | 8.4 | 10.2 |
| "Diakar" | 9.6 | 12.4 | 14.7 |
| "TEK Tver-regiontorf" | 10.5 | 15.2 | 19.1 |
| "Tverskaya fuel and energy company" | 16.2 | 20.3 | 25.5 |

*Source:* calculated by the authors based on the Tver Region peat producing enterprises reporting data

Analysis of the data given in Table 6 showed that the economic security of all these four peat enterprises was deteriorated by 2019. The "Peat Company" is in relatively security, but it should be noted that this enterprise has the highest quality resource base with predominance of lowland type peat. The performed economic security diagnostics made it possible to determine the main problems of the crisis conditions at the peat-extracting enterprises in the Tver Region (Table 7).

Not feeling the real support of the regional authorities, the peat extracting enterprises are developing an anti-crisis development strategy and, as the primary anti-crisis measures, use a simplified taxation system and are registered as micro-enterprises. These measures allow to reduce the tax burden, but they are clearly not enough to mitigate the threats to economic security. The statistical data for the region mining sector are also ambiguous.

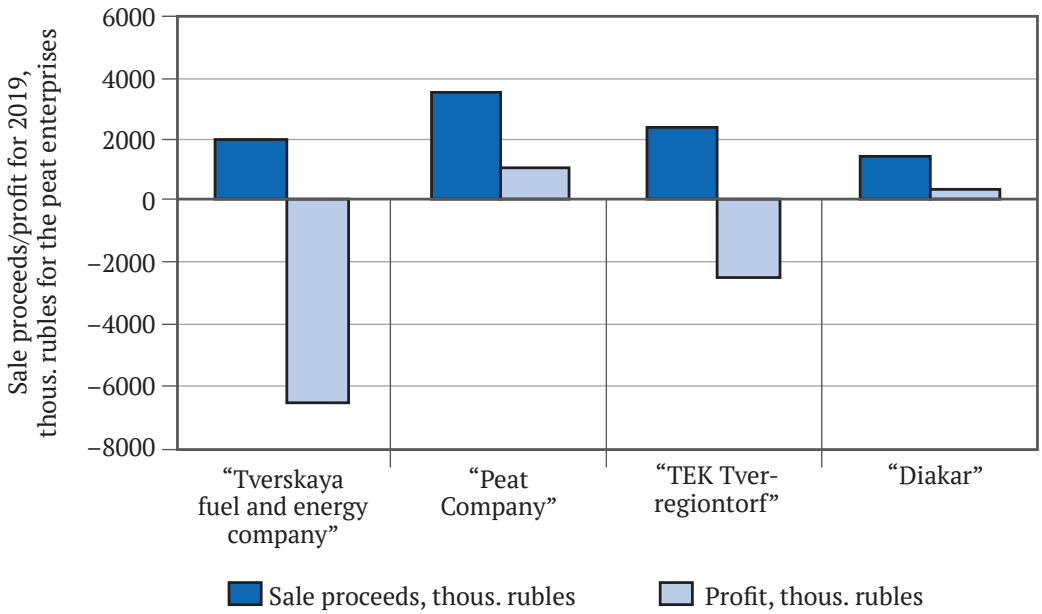


**Fig. 4.** Sale proceeds and profit of peat extracting enterprises of the Tver Region for 2019 *(compiled by the authors)*

For instance, until 2016, the extraction of fuel and energy resources (fuel peat) was carried out in the Tver Region, but since 2017 there are no data on the region peat extracting enterprises, while there are no data on the share of unprofitable enterprises in this sector of economic activity. Although the archives of the Tver Region Arbitration Court contain a sufficient number of bankruptcy cases of the peat extracting enterprises.

Table 7

**Problems of economic security of peat enterprises**

| Company | Economic security problems |
|---|---|
| "Peat Company" | 1. Decrease in volume of peat extraction;<br>2. Lack of free funds;<br>3. Suboptimal structure of the process equipment fleet;<br>4. Peat product sales problems |
| "Diakar" | 1. Average wear and tear of equipment;<br>2. Decrease in volume of peat extraction;<br>3. Lack of free funds;<br>4. Decreased liquidity;<br>5. Peat product sales problems |
| "TEK Tver-regiontorf" [22–25] | 1. Large percentage of equipment wear;<br>2. Suboptimal structure of the process equipment fleet;<br>3. Decrease in volume of peat extraction;<br>4. Lack of free funds;<br>5. Liquidity loss<br>6. Peat product sales problems;<br>7. Poor quality of resource base |
| "Tverskaya fuel and energy company" | 1. Large percentage of equipment wear;<br>2. Decrease in volume of peat extraction;<br>3. Lack of free funds;<br>4. Suboptimal structure of the process equipment fleet;<br>5. Liquidity loss<br>6. Peat product sales problems;<br>7. Depletion of resource base |

*Source:* compiled by the authors.

## Conclusion

Since the diagnostics and assessment of the economic security of the peat industry enterprises in the Tver Region made it possible to assert that all the peat extracting enterprises faced practically the same set of problems, the following program of anti-crisis measures could be proposed to mitigate the risks of losing economic security:

1. To improve technological process safety:

– improving the quality of the process equipment through the equipment modernization;

– control of the timely implementation and quality of service maintenance of the equipment;

– improvement of the used peat extraction methods or individual operations of the process cycle;

– optimization of the peat extracting equipment fleet structure;

– implementation of the processes for deep and complex processing of raw peat;

– introduction of new approaches to planning "full cycle" peat extraction and processing processes;

– use of automated and information technologies for business process management;

2. To improve financial security:

– optimization of taxation regimes and tax payments;

– increasing production efficiency;

– optimization of production costs, control of the costs of peat extraction;

– introduction of information technologies for the analysis of the economic and financial conditions of peat enterprises;

3. To improve personnel security:

– optimization of staffing structure;

– improvement of labor remuneration systems;

– stimulation of productivity growth and labor quality;

4. To improve investment security:

– monitoring of investment projects for compliance with the adopted strategy for peat production development;

– systematic implementation of a comprehensive marketing analysis of the markets for peat products and peat extracting equipment;

– monitoring of equity to debt ratio of peat producing enterprises.

The authors' approach to the diagnostics and assessment of the peat industry enterprises economic security allows to completely rethink the existing design methods for peat extracting enterprises and develop recommendations for increasing the flexibility and adaptability of peat extracting enterprises, taking into account the individual conditions of their operation.

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